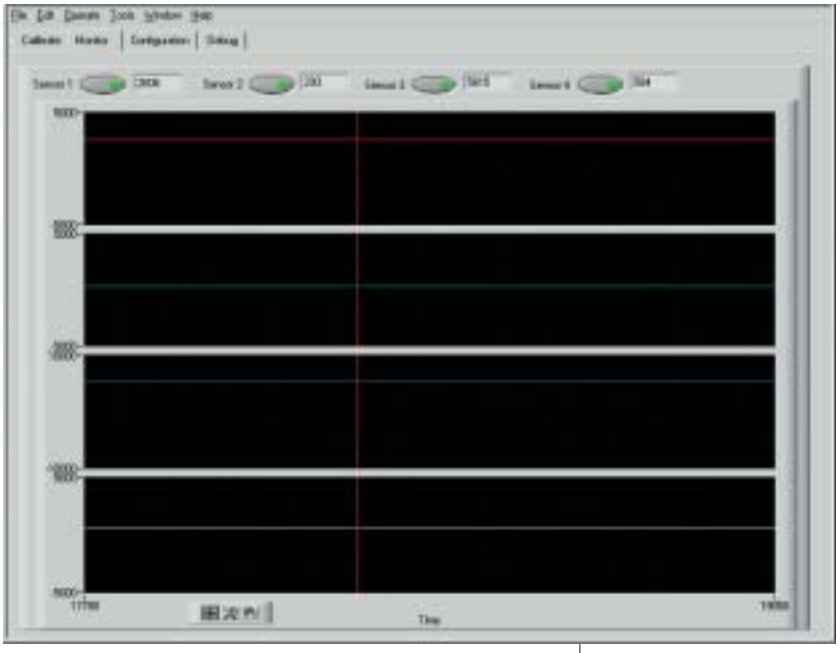
Combining Sense and Intelligence for Smarter Structures

In an effort to keep pace with the demands of a continuously growing society and a new millennium, builders, engineers, and architects are constructing taller skyscrapers, longer bridges, and faster aircraft. But with these savvy technological advancements comes the need for a superior safety system that can provide real-time structural data to prevent the possibility of catastrophic failure. Intelligent Fiber Optic Systems (IFOS), Inc., a leading photonic company located in Sunnyvale, California, believes it has a viable solution: the company has positioned itself for rapid growth in the optical networking market with the development of the I*Sense™ 14000 Fiber-Optic Spectral Monitoring System, a high-speed, high-precision, modular measurement application.

IFOS developed the I*Sense technology with assistance from a NASA Langley Research Center **Small Business Innovation Research (SBIR)** contract. NASA and IFOS collaborated to create sensing network designs that have high sensitivity, low power consumption, and significant potential for mass production. The joint-research effort led to the development of a module that is rugged, compact and light-weight, and immune to electromagnetic interference. These features make the I*Sense multisensor arrays favorable for smart structure applications, including smart buildings, bridges, highways, dams, power plants, ships, and oil tankers, as well as space vehicles, space stations, and other space structures. For instance, the system can be used as an early warning and detection device, with alarms being set to monitor the maximum allowable strain and stress values at various points of a given structure.

IFOS continued to enhance the product design even further by adding multiple sensors on a single fiber. The I*Sense 14000 model makes parallel, high-bandwidth measurement of signals within an array of multiplexed optical sensors technically possible and economical. The technology has the capability to monitor optical systems that are up to several kilometers from the unit on a single 250-micrometer diameter optical fiber. Moreover, the system's data acquisition software and hardware permit the monitoring of four wavelengths per fiber module, and are expandable to accommodate

*The I*Sense™ 14000 detects strain and stress values of smart structures, such as bridges, buildings, and dams.*



*The acquisition software for the I*Sense™ 14000 returns real-time sensor feedback to a personal computer.*

monitoring systems with multiple module configurations; all units are compatible with personal computers equipped with Microsoft® Windows® operating systems. The company is also pressing ahead with its latest commercial model, the I*Sense 18000, which allows for parallel, high-bandwidth measurement of eight multiplexed optical sensors.

The aerospace industry has expressed considerable interest in employing I*Sense systems to monitor operational parameters and structural integrity. More specifically, aerospace companies are considering utilization of the sensing systems with composite materials to reduce the cost and weight of airframes. According to IFOS, its fiber sensors offer distinct advantages over electrical sensors, ultimately making the I*Sense networks a perfect match for smart skins on both aircraft and space vehicles, as well as many other aerospace structural health monitoring applications, including supersonic transport.

While IFOS' focus to date has been on multiplexed strain sensing applications, it is planning to advance the I*Sense technology even further with applications in temperature and pressure sensing. The company notes that the I*Sense system's fiber Bragg grating building-blocks (wavelength-selective reflectors embedded inside the fiber through a specialized fabrication process) could potentially be used with materials that are electrostrictive, magnetostrictive, and piezoelectric to act as transducers for measurement of electric and magnetic fields, voltages, acceleration, velocity, displacement, and vibration frequency. Temperature-sensitive environments, such as greenhouses, arctic and marine regions, and space, may also benefit greatly from the monitoring capabilities of I*Sense. ❖

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